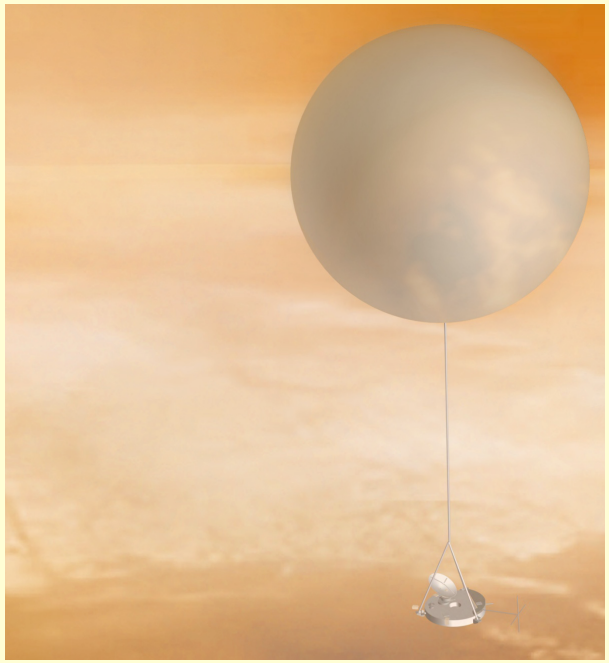
Titan Aerial Explorer
Science to be performed



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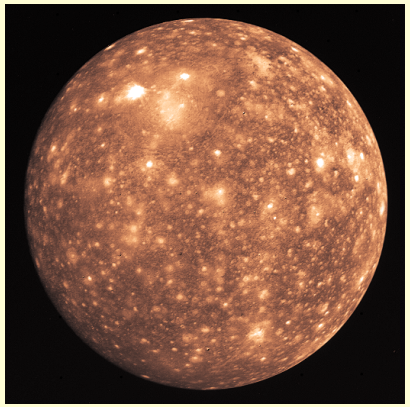
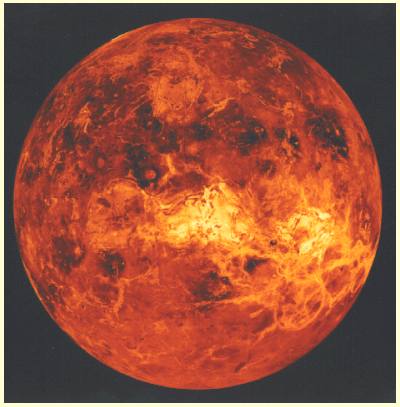
University of Rome, Italy
Jet Propulsion Laboratory, Pasadena, CA, USA

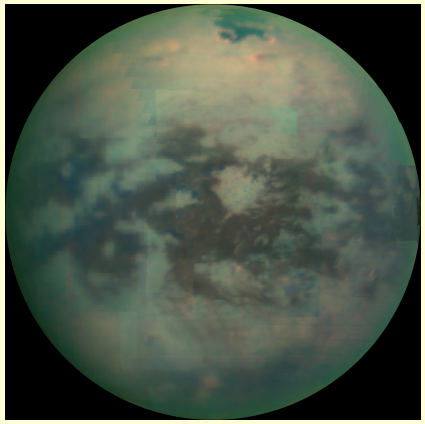
- What makes Titan a unique place ?
- Cassini discoveries – role of Huygens
- Unique science that a balloon can perform

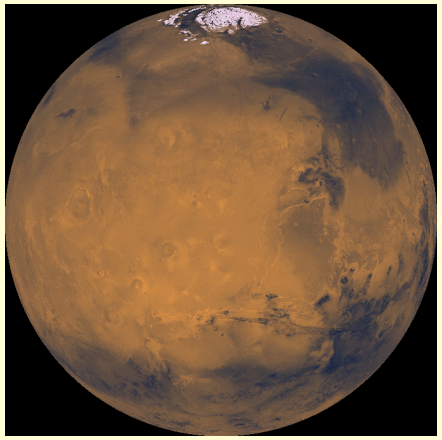
Titan



Increasing atmospheric density at surface





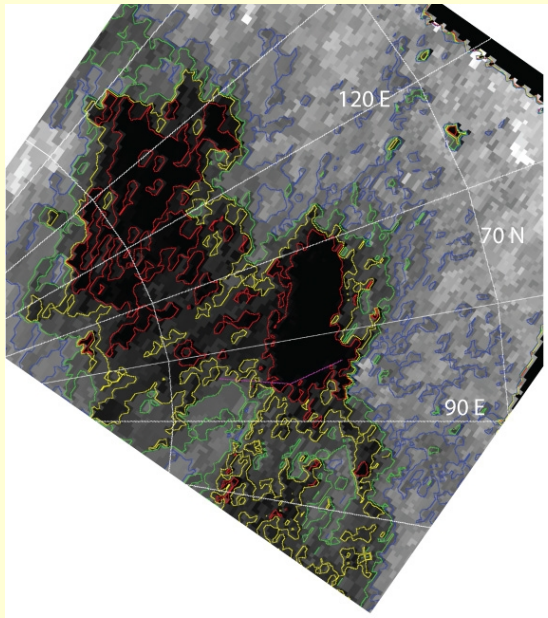


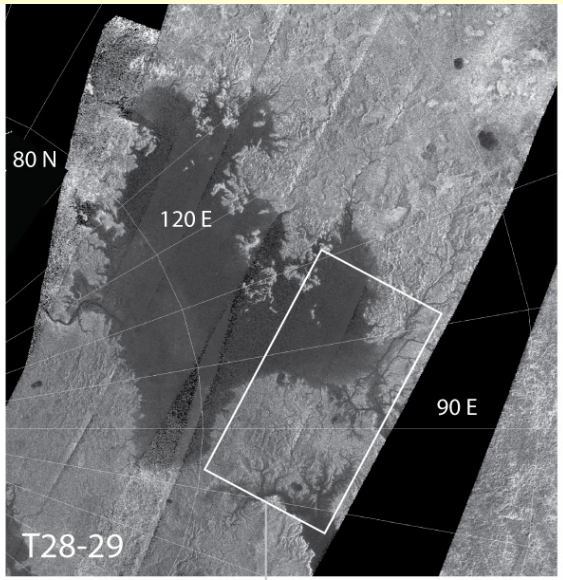
Increasing size

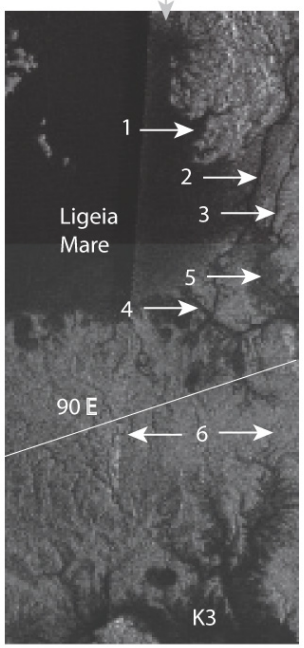
Titan can be compared to the Earth-like planet in terms of **global processes** implying exchanges between the interior and the atmosphere and erosion processes driven by meteorological conditions

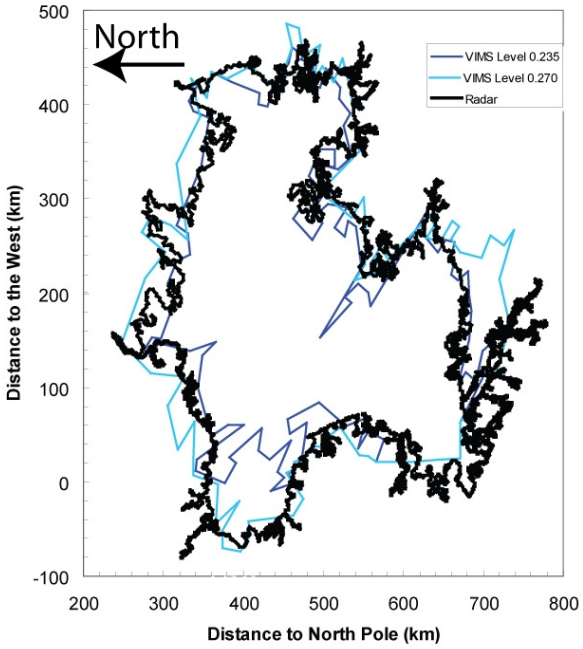
It can also be compared with the largest icy moons such as Europa, Ganymede and Callisto for its **interior structure**.

Ligeia Mare









Observations in April 2007 and December 2009 by radar and June 2010 by VIMS

CH_4

180,000 GT

≈200 kg/s

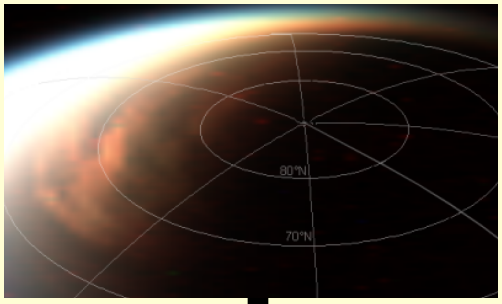
≈ 30 Myr

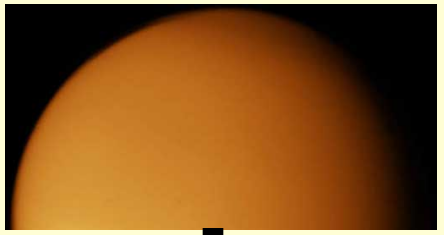
C_2H_6

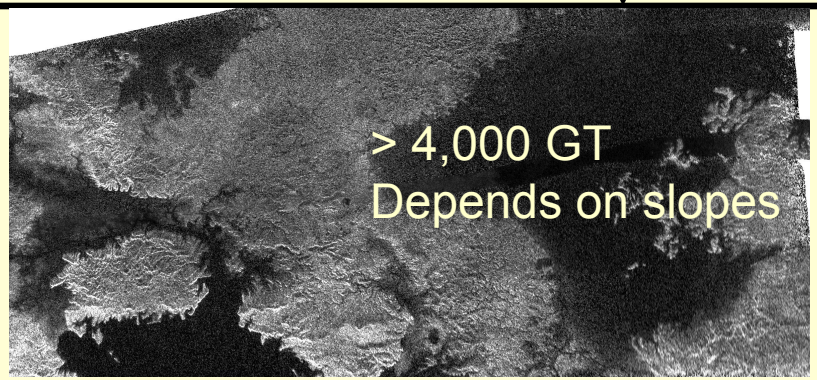
2 GT

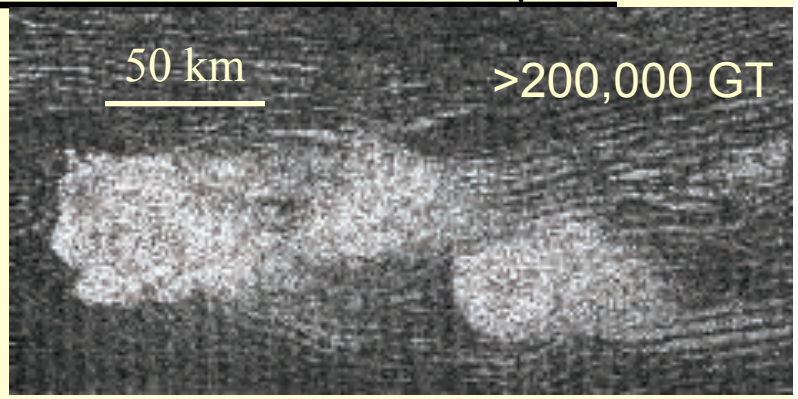
Haze particle
3000 monomers
5 /cm^3 – ϕ=150 μm

0.14 GT





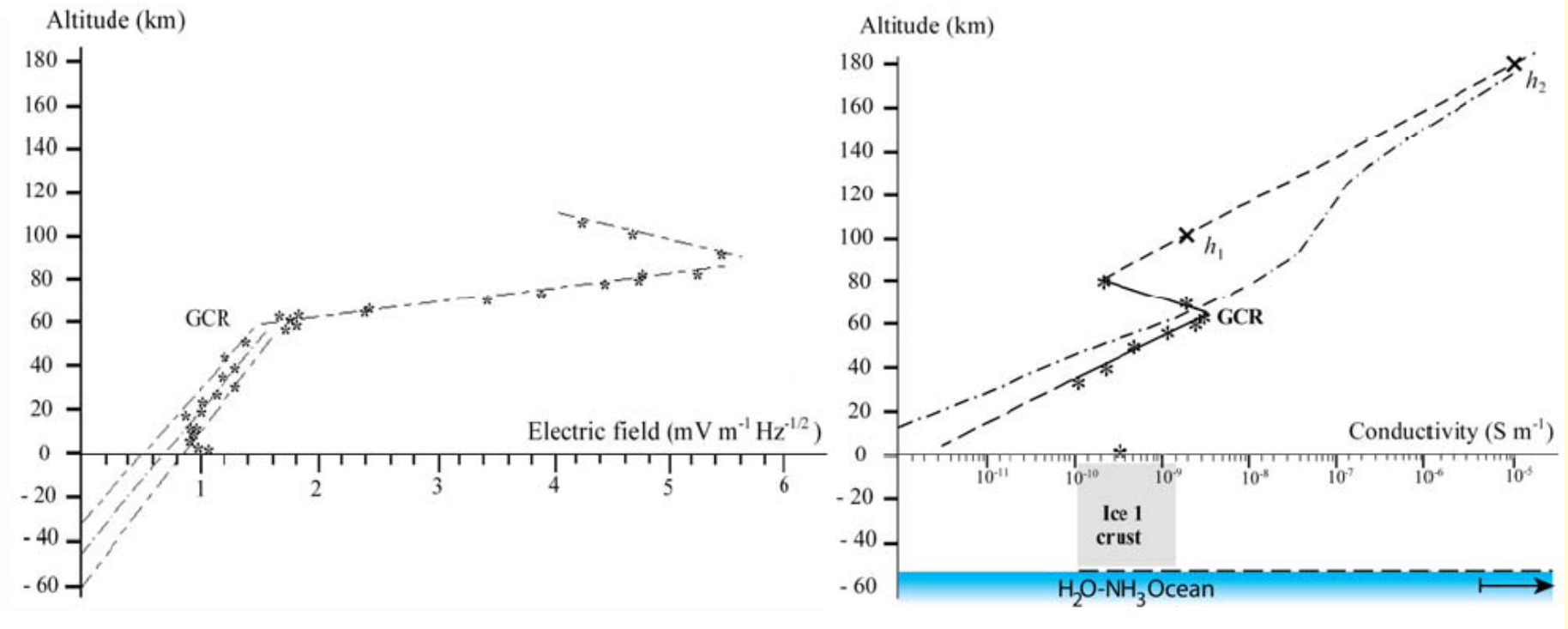




When ?
Where ?
How ?

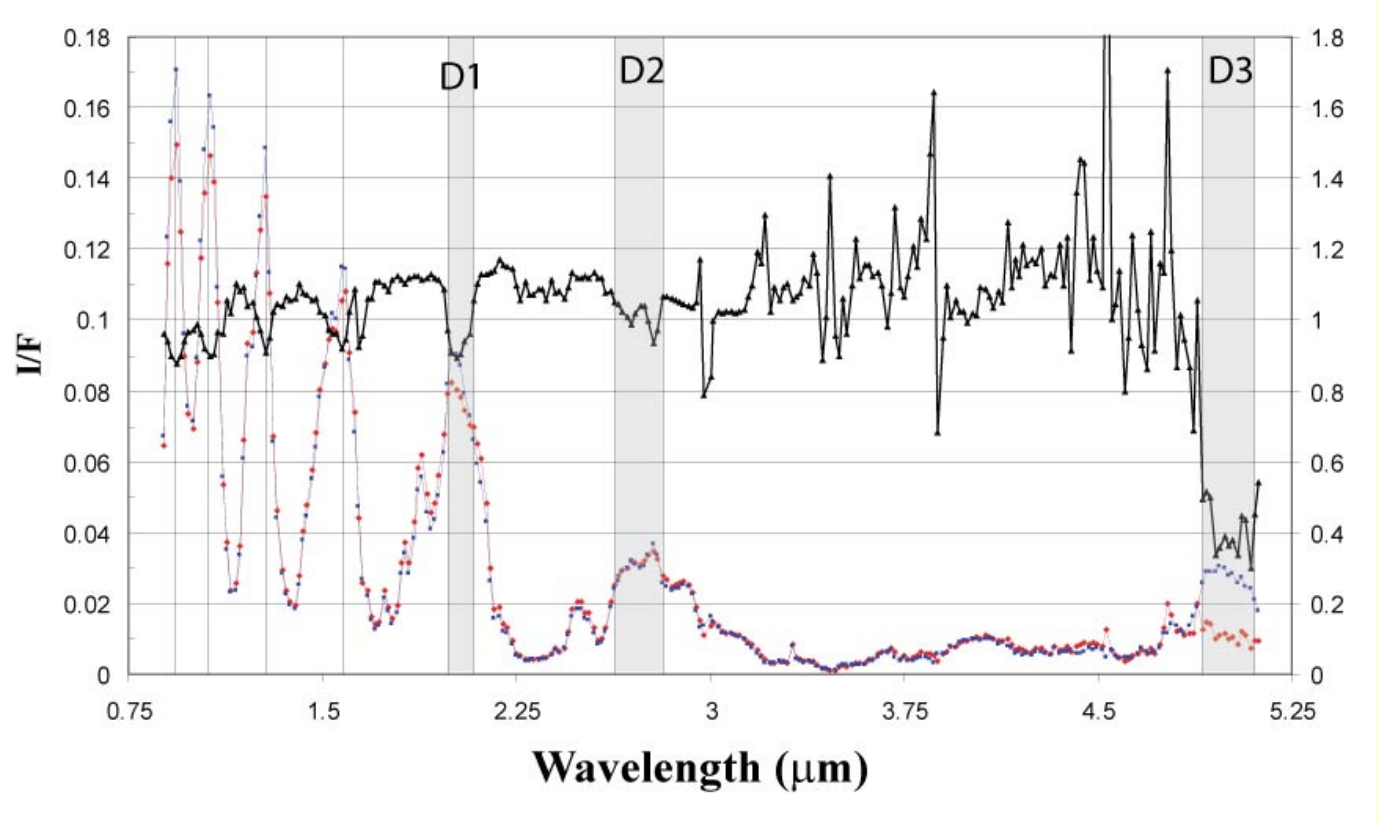
Clathrates in the subsurface – 10 to 20% of the mass of the crust
1 km * surface of Ligeia would contain 30,000 GT of C

Electric field in Titan's atmosphere (Beghin et al., 2009, 2010)



The decrease with altitude of the strength of the horizontal component of the 36 Hz electric field is consistent with the presence of a Schumann resonance triggered and sustained by ionospheric currents (Beghin et al., 2009 and 2010). It requires the presence of a conductive layer at 70 km (10) depth: it could be a deep ammonia-rich ocean.

Infrared observations through Titan's atmosphere



7 windows in the near infrared
Still to worry about scattering by aerosols

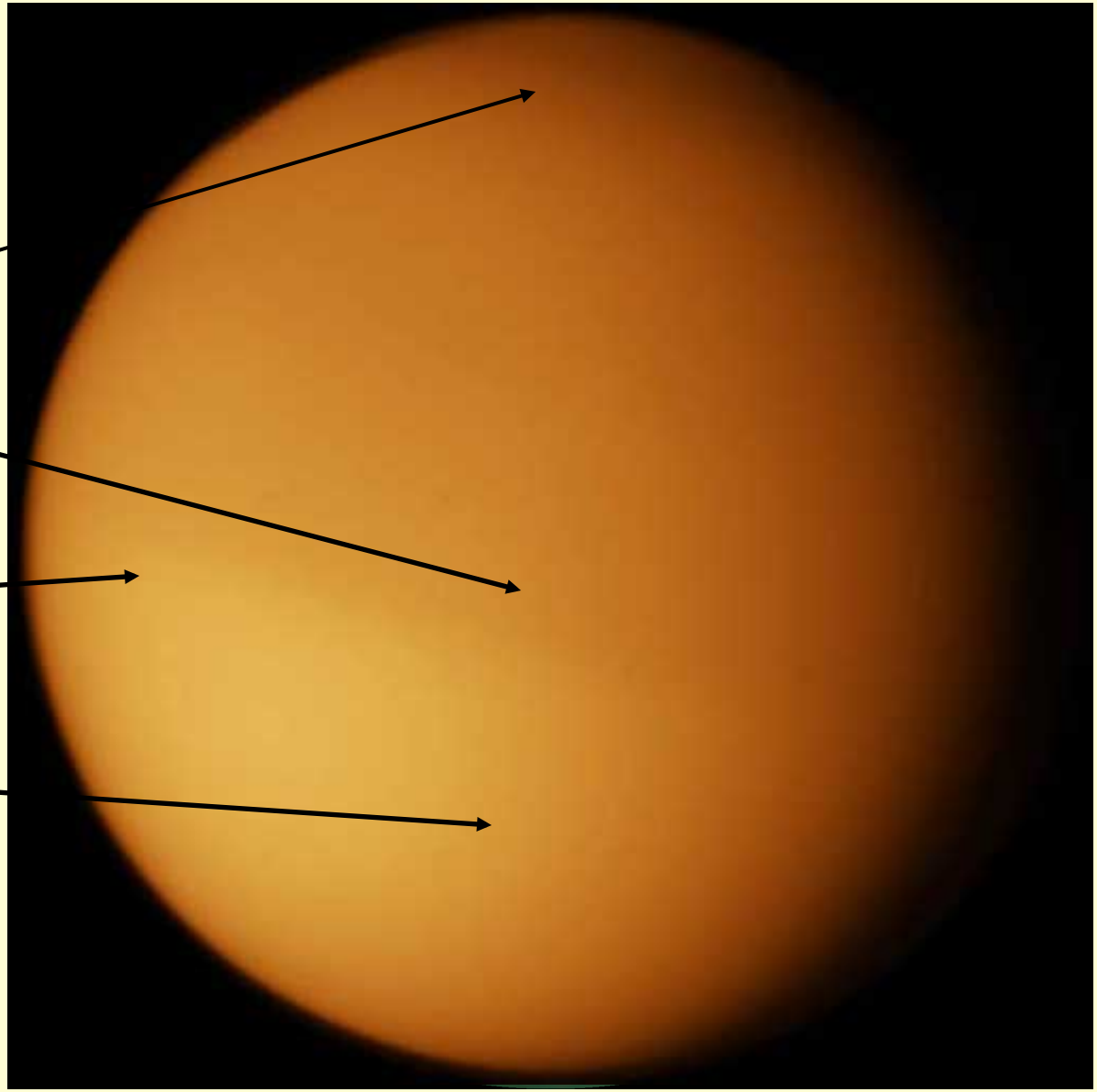
R=2575 km
e=2.92%
d=1.881

Kraken Mare

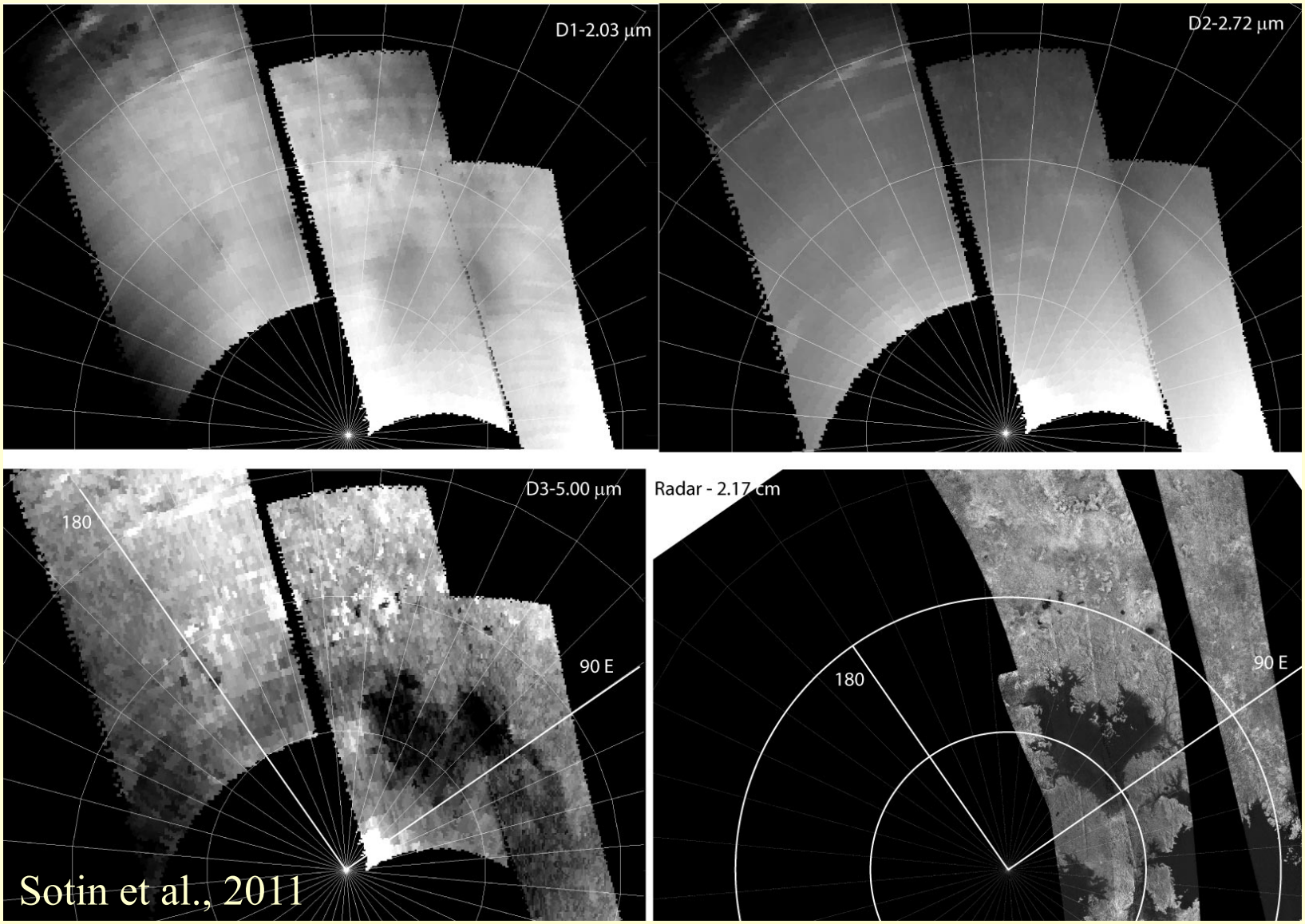
Dune fields

Bright plateaus carved by rivers

Mountains



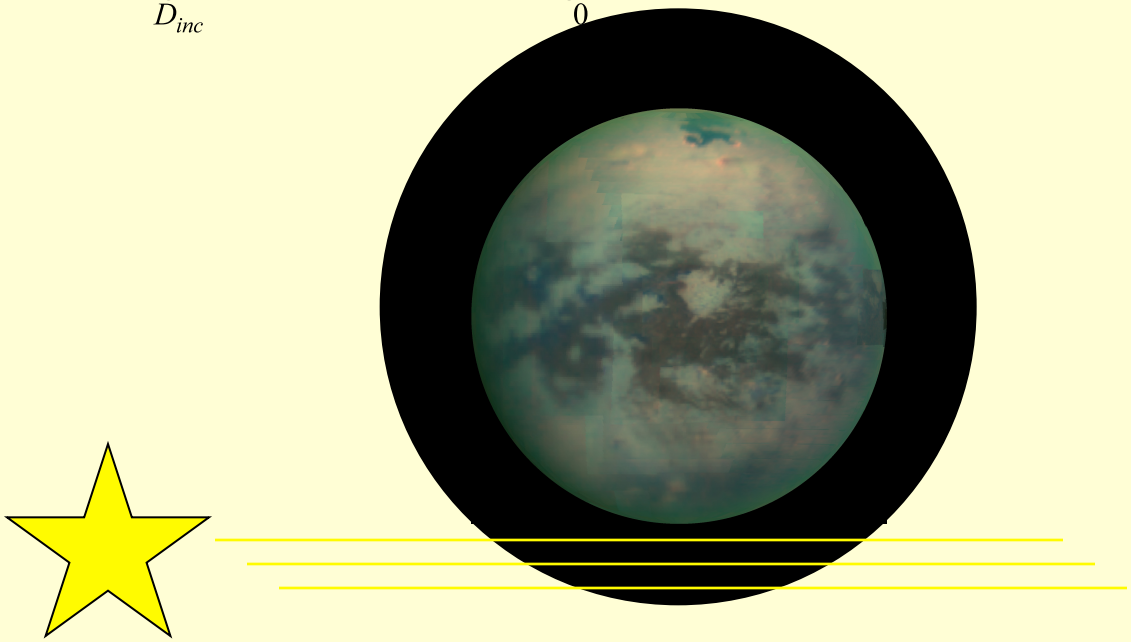
Infrared observations through Titan's atmosphere

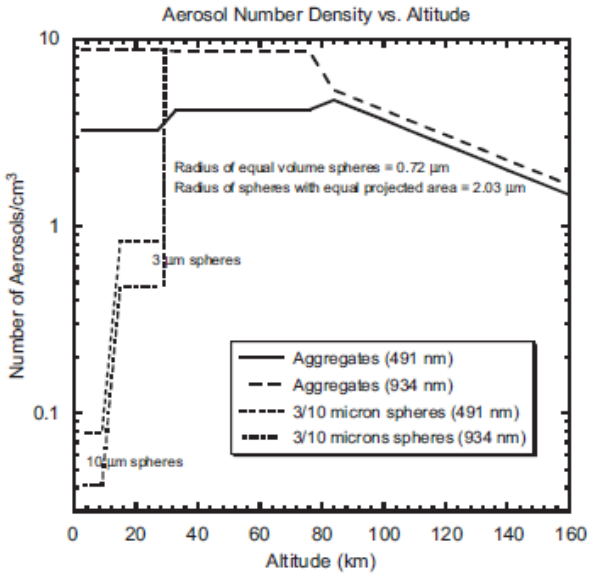


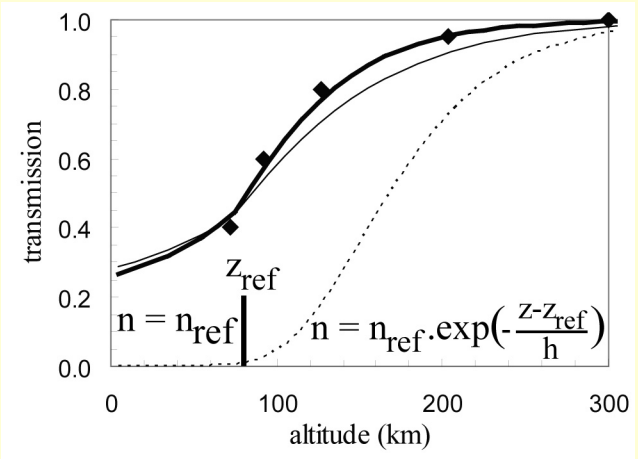
Role of Huygens in determining the scattering properties of the atmosphere

$$I(\lambda,\phi) = F(\lambda).\cos(i).R_S(\lambda).\exp(-\tau_{atm}) + I_{scattered}(\lambda,\phi)$$

$$\tau_{atm} = \int_{D_{inc}}^{0} \sigma_{Scat}(\lambda) n(z) dl + \int_{0}^{D_{emi}} \sigma_{Scat}(\lambda) n(z) dl$$







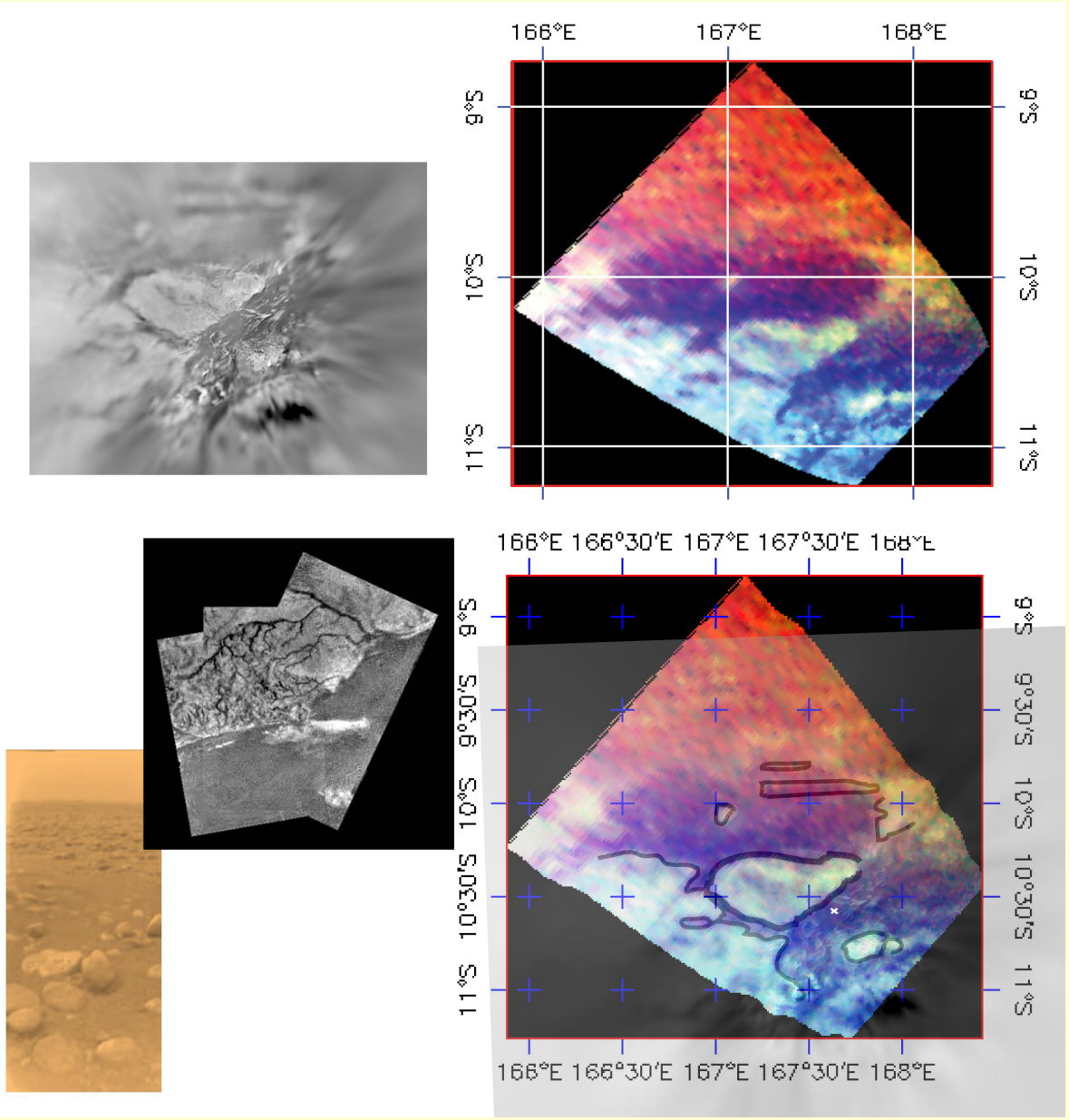
- Solar occultation can probe the atmosphere from 1000 down to 70 km (Bellucci et al., 2008)
- Huygens provided the information about the number density of particles in the last 80 km
- Future missions should analyze those particles at an altitude of a few (tens) of kms

Comparison DISR - VIMS

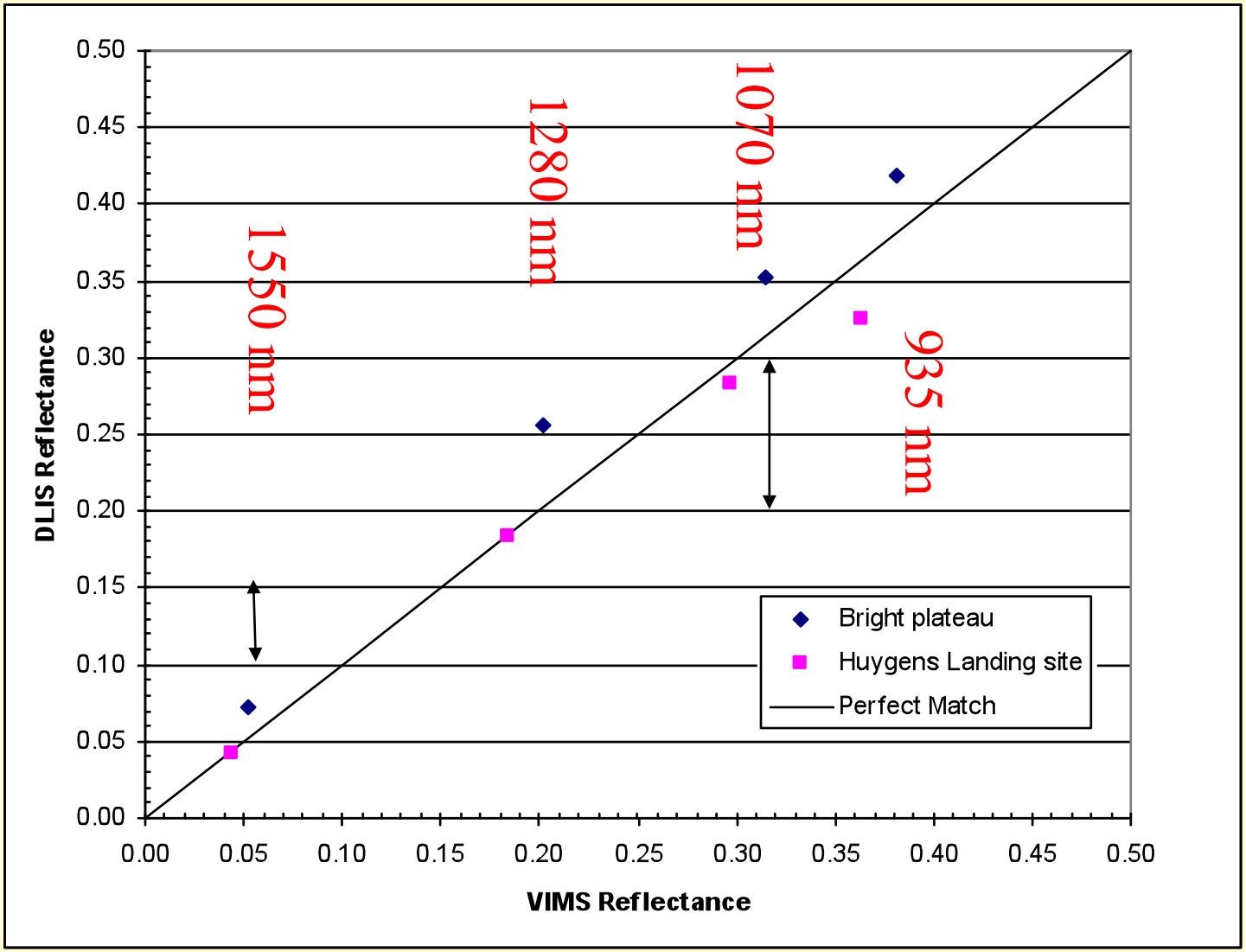
Synthesis to show the difference between a 1.2 km resolution image (VIMS) and the few meter resolution images obtained by DISR.

The resolution turns a boring area into an active place where rivers and erosion processes have operated.

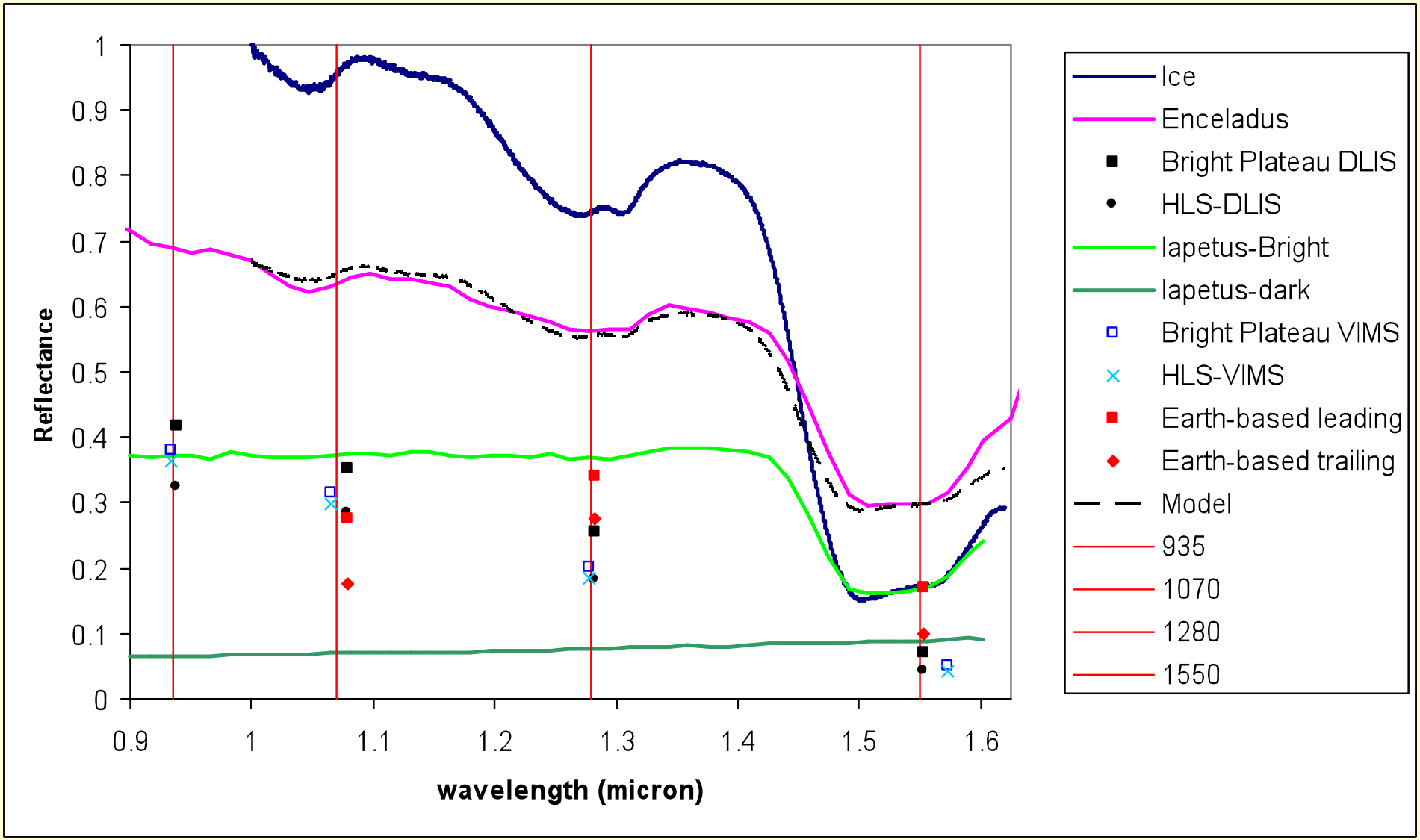
It emphasizes the importance of Huygens observations.



Infrared observations through Titan's atmosphere

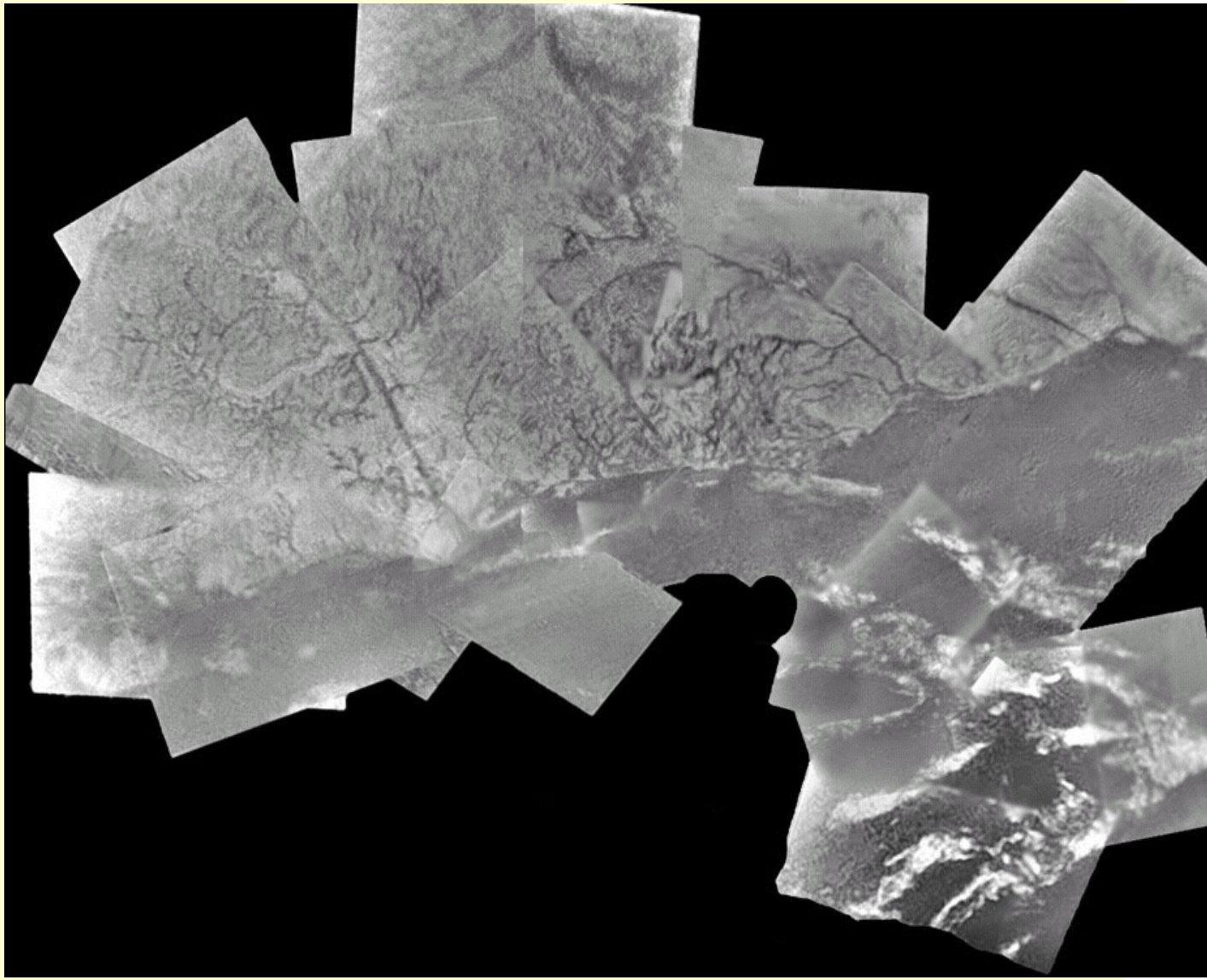


Composition of the surface



The Huygens landing site

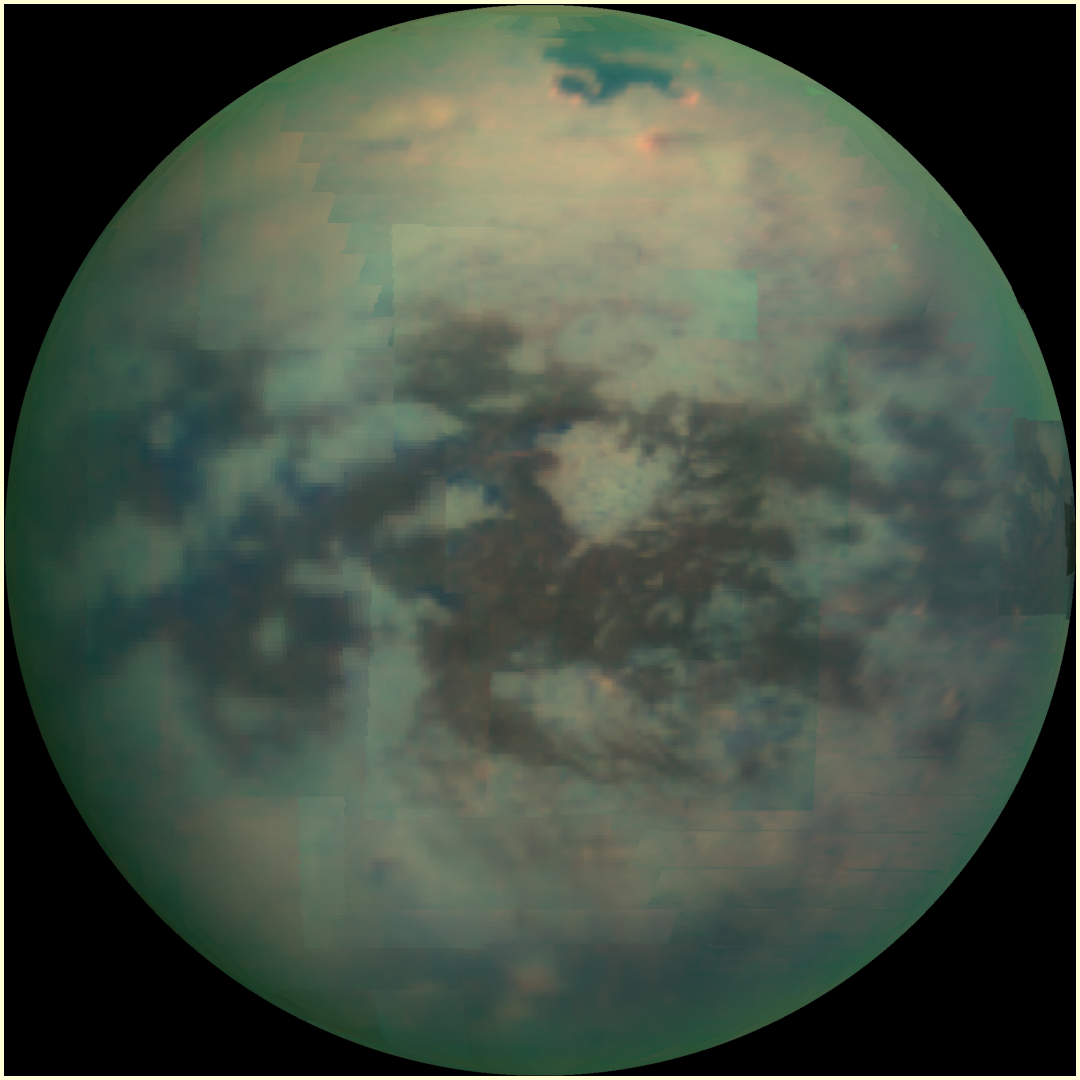
The Huygens observations took place in January 2005. At an altitude of 16 km, the resolution is close to 20 m/pixel. The surface area of one image is 16 km^2. It gives an idea of what a balloon could do for imaging.



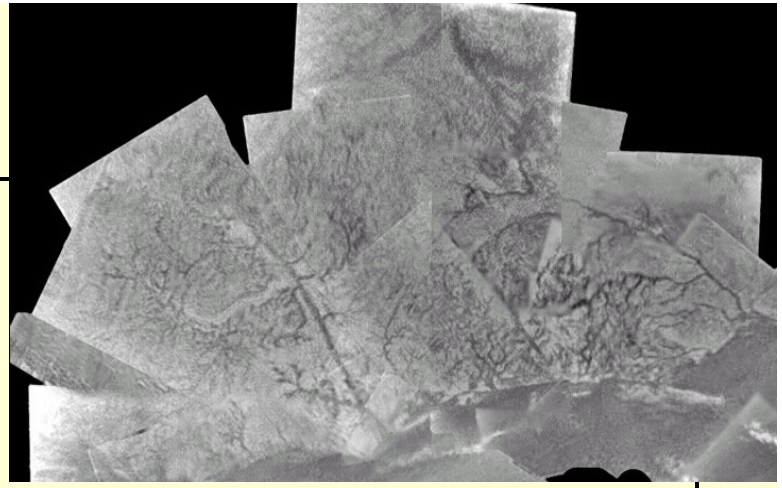
Different areas to analyze in the tropical region

There are several areas of interest in the equatorial region, including:

- Dunes fields
- Bright plateaus
- Impact craters
- River networks
- Mountain chains



Conclusions



- Titan is a unique natural laboratory to study how complex organic molecules form
- This atmosphere is also an obstacle to study the geology of Titan's surface
- A balloon floating in the troposphere would be able to take high resolution images (10 to 1 m/pixel) of a large fraction of Titan's surface
- It would provide important information on the wind speed in the troposphere as well as the composition of the troposphere
- Aerosols could be characterized (size distribution, composition)
- Rain drops could be analyzed
- Lateral variations of (E,B) field could be determined and would provide information on the characteristics of the subsurface
- Data would be ground truth for remote sensing data
- Diurnal and seasonal variations (rain falls)
- ……..